

6. Auger-Electron Intensities

Table 8 lists intensities for K-Auger electrons whose intensities are greater than 0.001 per 100 vacancies in the K atomic shell. The first column identifies the Auger transitions, using the notation K-XY, where X and Y represent the inner atomic shells involved in the K-Auger-electron emission process. The following columns give, for each element, the K-Auger-electron intensities, I_{K-XY} . These have been derived from the theoretical emission probabilities through the relationship

$$I_{K-XY} = 100(1 - \omega_K) \frac{P_{K-XY}}{\sum P_{K-XY}}, \quad (1)$$

where P_{K-XY} is the theoretical emission probability of a K-XY Auger electron, from Chen, et al.,¹ ω_K is the K fluorescence yield, from Krause,² and the summation is over all Auger electrons which are energetically possible.

Approximate Auger-electron energies can be calculated with the empirical equations of Dillman.³ The average energy for a K-L_iX Auger transition is given by

$$\bar{E}(K-L_iX) = E_K - E_{L_i} - E_{M_3} - 0.75(E_{M_3^+} - E_{M_3}), \quad (2)$$

and for higher atomic shells, by

$$\bar{E}(K-XY) = E_K - 2E_{M_3} - 0.75(E_{M_3^+} - E_{M_3}). \quad (3)$$

E_{L_i} is the binding energy of the L_i atomic shell for the element, E_K and E_{M_3} are the corresponding binding energies of the K and M₃ atomic shells, $E_{M_3^+}$ is the binding energy of the M₃ atomic subshell for the next higher element, and X and Y are designations for the higher atomic subshells. For more precise Auger-electron energies, one is referred to the publication of Larkins.⁴

¹ M.H. Chen, B. Crasemann, and H. Mark, Atomic Data and Nucl. Data Tables **24**, 13 (1979).

² M.O. Krause, J. Phys. Chem. Ref. Data **8**, 307 (1979).

³ EDISTR - A Computer Program to Obtain a Nuclear Decay Data Base for Radiation Dosimetry, L.T. Dillman, Oak Ridge National Lab. Report ORNL/TM-6689 (1980).

⁴ F.B. Larkins, Atomic Data and Nucl. Data Tables **20**, 313 (1977).

Table 8. Auger-Electron Intensities per 100 K-Shell Vacancies

	¹⁸ Ar	¹⁹ K	²⁰ Ca	²¹ Sc	²² Ti	²³ V	²⁴ Cr	²⁵ Mn	²⁶ Fe	²⁷ Co	²⁸ Ni	²⁹ Cu	³⁰ Zn	³¹ Ga	³² Ge	
K-L ₁ L ₁	6.1	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.4	4.2	4.0	3.8	3.6	3.4	3.3	
K-L ₁ L ₂	6.7	6.4	6.2	6.0	5.8	5.6	5.4	5.1	4.9	4.7	4.5	4.3	4.0	3.8	3.7	
K-L ₁ L ₃	12.8	12.2	11.7	11.3	10.9	10.4	10.0	9.4	9.0	8.5	8.0	7.5	7.1	6.7	6.3	
K-L ₁ M ₁	1.35	1.39	1.40	1.38	1.36	1.32	1.28	1.23	1.17	1.12	1.07	1.02	0.97	0.94	0.91	
K-L ₁ M ₂	0.63	0.69	0.72	0.71	0.70	0.69	0.68	0.65	0.62	0.60	0.57	0.55	0.53	0.52	0.51	
K-L ₁ M ₃	1.20	1.30	1.35	1.34	1.31	1.28	1.24	1.19	1.13	1.08	1.02	0.97	0.92	0.89	0.86	
K-L ₁ M ₄								0.030	0.029	0.029	0.029	0.029	0.029	0.032	0.033	
K-L ₁ M ₅								0.0076	0.0176	0.026	0.032	0.037	0.040	0.042	0.044	
K-L ₁ N ₁				0.159	0.150	0.141	0.132	0.123	0.113	0.097	0.085	0.078	0.075	0.074	0.083	0.089
K-L ₂ L ₂	1.23	1.18	1.13	1.10	1.07	1.03	0.99	0.94	0.90	0.85	0.81	0.76	0.72	0.68	0.64	
K-L ₂ L ₃	30	29	28	27	26	24.9	23.8	22.5	21.4	20.3	19.1	18.0	16.8	15.8	14.9	
K-L ₂ M ₁	0.65	0.67	0.67	0.66	0.65	0.63	0.61	0.59	0.56	0.54	0.51	0.49	0.46	0.45	0.43	
K-L ₂ M ₂	0.221	0.239	0.248	0.247	0.244	0.239	0.233	0.224	0.214	0.204	0.195	0.185	0.176	0.170	0.165	
K-L ₂ M ₃	2.53	2.7	2.8	2.8	2.7	2.7	2.6	2.46	2.33	2.21	2.10	1.98	1.88	1.81	1.74	
K-L ₂ M ₄								0.043	0.042	0.041	0.041	0.041	0.041	0.043	0.044	
K-L ₂ M ₅								0.028	0.065	0.096	0.119	0.137	0.148	0.156	0.162	
K-L ₂ N ₁				0.074	0.070	0.066	0.062	0.057	0.053	0.045	0.040	0.037	0.035	0.034	0.038	0.041
K-L ₃ L ₃	17.2	16.5	15.7	15.2	14.6	14.0	13.3	12.6	12.0	11.3	10.6	9.9	9.3	8.6	8.0	
K-L ₃ M ₁	1.25	1.28	1.28	1.25	1.22	1.18	1.13	1.08	1.02	0.97	0.92	0.86	0.81	0.72	0.66	
K-L ₃ M ₂	2.53	2.7	2.8	2.8	2.7	2.7	2.6	2.46	2.34	2.22	2.10	1.99	1.88	1.66	1.54	
K-L ₃ M ₃	2.9	3.1	3.2	3.2	3.1	3.0	2.9	2.8	2.6	2.50	2.37	2.24	2.11	1.88	1.74	
K-L ₃ M ₄								0.194	0.188	0.184	0.181	0.180	0.179	0.144	0.132	
K-L ₃ M ₅				0.142	0.083	0.046	0.028	0.0241	0.033	0.080	0.117	0.146	0.167	0.181	0.145	0.133
K-L ₃ N ₁								0.098	0.083	0.073	0.066	0.062	0.060	0.037	0.030	
K-M ₁ M ₁	0.075	0.084	0.089	0.088	0.087	0.086	0.083	0.081	0.077	0.074	0.071	0.068	0.066	0.052	0.047	
K-M ₁ M ₂	0.063	0.072	0.078	0.079	0.080	0.079	0.078	0.075	0.071	0.068	0.065	0.063	0.060	0.046	0.040	
K-M ₁ M ₃	0.117	0.137	0.149	0.149	0.147	0.145	0.141	0.136	0.129	0.123	0.117	0.112	0.107	0.087	0.078	
K-M ₁ N ₁				0.0213	0.0199	0.0187	0.0175	0.0163	0.0151	0.0130	0.0115	0.0107	0.0103	0.0104	0.0032	
K-M ₂ M ₃	0.217	0.26	0.29	0.30	0.29	0.29	0.28	0.27	0.26	0.245	0.234	0.223	0.214	0.177	0.160	
K-M ₂ N ₁				0.0106	0.0100	0.0094	0.0088	0.0082	0.0076	0.0065	0.0058	0.0054	0.0052	0.00214	0.00120	
K-M ₃ M ₃	0.125	0.153	0.170	0.172	0.171	0.169	0.165	0.158	0.149	0.140	0.133	0.126	0.121	0.10	0.091	
K-M ₃ M ₄								0.0176	0.0171	0.0169	0.0169	0.0170	0.0173	0.0123	0.0108	
K-M ₃ M ₅				0.0177	0.0166	0.0156	0.0146	0.0136	0.0126	0.0108	0.0096	0.0089	0.0086	0.0043	0.0030	
	³³ As	³⁴ Se	³⁵ Br	³⁶ Kr	³⁷ Rb	³⁸ Sr	³⁹ Y	⁴⁰ Zr	⁴¹ Nb	⁴² Mo	⁴³ Tc	⁴⁴ Ru	⁴⁵ Rh	⁴⁶ Pd	⁴⁷ Ag	
K-L ₁ L ₁	3.1	2.9	2.6	2.40	2.27	2.14	2.02	1.90	1.79	1.67	1.58	1.49	1.40	1.32	1.25	
K-L ₁ L ₂	3.5	3.2	3.0	2.7	2.55	2.41	2.28	2.15	2.03	1.90	1.80	1.71	1.61	1.53	1.45	
K-L ₁ L ₃	5.9	5.5	4.9	4.4	4.1	3.9	3.6	3.3	3.1	2.9	2.7	2.49	2.31	2.15	2.01	
K-L ₁ M ₁	0.88	0.83	0.77	0.71	0.68	0.65	0.63	0.60	0.57	0.54	0.51	0.49	0.47	0.44	0.42	
K-L ₁ M ₂	0.49	0.47	0.44	0.41	0.39	0.38	0.36	0.35	0.33	0.32	0.31	0.29	0.28	0.27	0.26	
K-L ₁ M ₃	0.83	0.78	0.72	0.66	0.63	0.60	0.57	0.54	0.51	0.48	0.45	0.43	0.40	0.38	0.36	
K-L ₁ M ₄	0.034	0.034	0.033	0.031	0.031	0.030	0.030	0.029	0.028	0.027	0.026	0.0255	0.0245	0.0237	0.0229	
K-L ₁ M ₅	0.045	0.044	0.041	0.039	0.039	0.038	0.037	0.036	0.034	0.033	0.032	0.030	0.029	0.027	0.026	
K-L ₁ N ₁	0.094	0.096	0.094	0.092	0.096	0.098	0.099	0.098	0.096	0.094	0.091	0.089	0.086	0.084	0.081	
K-L ₁ N ₂				0.040	0.040	0.044	0.047	0.049	0.050	0.049	0.048	0.048	0.047	0.046	0.045	
K-L ₁ N ₃				0.049	0.065	0.071	0.074	0.076	0.076	0.075	0.073	0.071	0.068	0.066	0.064	
K-L ₁ O ₁													0.0042	0.0033	0.0036	
K-L ₂ L ₂	0.60	0.56	0.50	0.46	0.43	0.40	0.37	0.34	0.32	0.30	0.28	0.26	0.239	0.223	0.208	
K-L ₂ L ₃	13.9	12.9	11.5	10.4	9.7	9.0	8.3	7.7	7.1	6.6	6.1	5.7	5.2	4.8	4.5	
K-L ₂ M ₁	0.42	0.39	0.36	0.34	0.32	0.31	0.30	0.28	0.27	0.26	0.246	0.235	0.223	0.214	0.206	
K-L ₂ M ₂	0.158	0.149	0.137	0.126	0.120	0.114	0.108	0.102	0.097	0.091	0.085	0.080	0.075	0.071	0.067	
K-L ₂ M ₃	1.66	1.57	1.44	1.32	1.25	1.18	1.12	1.05	0.99	0.93	0.87	0.82	0.76	0.72	0.68	
K-L ₂ M ₄	0.045	0.044	0.043	0.041	0.040	0.039	0.039	0.037	0.037	0.035	0.034	0.032	0.031	0.029	0.028	
K-L ₂ M ₅	0.164	0.162	0.155	0.147	0.145	0.141	0.137	0.132	0.128	0.122	0.117	0.111	0.106	0.101	0.096	
K-L ₂ N ₁	0.043	0.044	0.043	0.045	0.046	0.046	0.045	0.044	0.043	0.042	0.041	0.040	0.039	0.038		
K-L ₂ N ₂				0.0123	0.0130	0.0140	0.0144	0.0146	0.0144	0.0139	0.0133	0.0130	0.0126	0.0122	0.0119	0.0116
K-L ₂ N ₃				0.098	0.128	0.138	0.144	0.147	0.145	0.141	0.136	0.132	0.128	0.122	0.117	0.112
K-L ₂ N ₅													0.0075	0.0095	0.0108	
K-L ₂ O ₁													0.00188	0.00145	0.00160	
K-L ₃ L ₃	7.5	6.9	6.3	5.7	5.3	4.9	4.5	4.1	3.8	3.5	3.2	3.0	2.7	2.53	2.34	
K-L ₃ M ₁	0.63	0.62	0.61	0.61	0.56	0.51	0.47	0.44	0.41	0.39	0.36	0.34	0.32	0.30	0.28	
K-L ₃ M ₂	1.47	1.45	1.44	1.46	1.33	1.22	1.13	1.05	0.99	0.92	0.86	0.81	0.76	0.71	0.67	
K-L ₃ M ₃	1.66	1.63	1.59	1.60	1.46	1.34	1.24	1.15	1.08	1.0	0.94	0.88	0.82	0.77	0.72	

